Surficial Geologic and Liquefaction Susceptibility Mapping in Shelby County, Tennessee

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Investigations Undertaken During Year Two

This is the second year of a two year geologic and liquefaction susceptibility mapping program. We are mapping the Germantown, Memphis Northeast, and the Ellendale 7.5 minute quadrangles in the city of Memphis and Shelby County, Tennessee (Fig. 1). In a previous study we mapped the Collierville and Memphis Northwest 7.5 minute quadrangles (Van Arsdale et al., 1998; Broughton et al., 2001). These five quadrangles align along a generally east-west line through Shelby County and contain the Wolf River flood plain, the principal area of liquefaction in Shelby County.

Earlier work identified earthquake liquefaction induced sand dikes exposed in cut banks of the Wolf and Loosahatchie rivers in the city of Memphis and Shelby County. The first year of this current two-year project involved geologic and liquefaction reconnaissance in the Memphis Northeast, Ellendale, and Germantown quadrangles. The Wolf River was floated and additional sand dikes were found along the Wolf River in the Memphis Northeast and Germantown quadrangles (Fig. 1). A second focus of year one was the acquisition and interpretation of 428 boring logs and well data for the three quadrangles. Geotechnical boring logs from Hwang et al. (1990; 1999), new engineering company boring logs, and boring logs from the Tennessee Department of Transportation were obtained and geologically interpreted. In addition, water well logs were obtained from the USGS and Shelby County Health Department. A total of 165 boring and well logs were interpreted for the Germantown quadrangle, 124 in the Ellendale quadrangle, and 139 in the Memphis Northeast quadrangle.

During year two, boring logs were interpreted in the Memphis Southeast quadrangle because subsurface mapping from year one suggested the presence of a northeast striking down-to-the-west fault in the adjacent Germantown and Ellendale quadrangles. During year two, surface geologic mapping was conducted in the Memphis Northeast, Germantown, and Ellendale quadrangles.

Results of Year Two

During the second year of this project we analyzed the borings and made structure contour maps of the top and bottom of the Pliocene-Pleistocene Lafayette Formation also called the Upland Gravel (Fig. 2). These structure contour maps reveal an apparent down-to-the-west displacement of the Lafayette Formation (Yates et al., 2001). We have interpreted this to be a fault with approximately 100 feet of displacement. This fault (herein called the Ellendale fault) appears to displace the Lafayette Formation and thus is Quaternary in age. However, there is no surface scarp along the Ellendale fault in the overlying surficial Pleistocene loess. The Ellendale fault strikes approximately N30E and passes through the center of the Ellendale quadrangle, through the northwest corner of the Germantown quadrangle, and into the eastern portion of the Memphis Southeast quadrangle (Fig. 2).

Preliminary geologic maps of the Memphis Northeast and Germantown quadrangles are nearly complete and mapping of the Ellendale quadrangle is in progress. From these geologic maps, liquefaction susceptibility maps will be made.

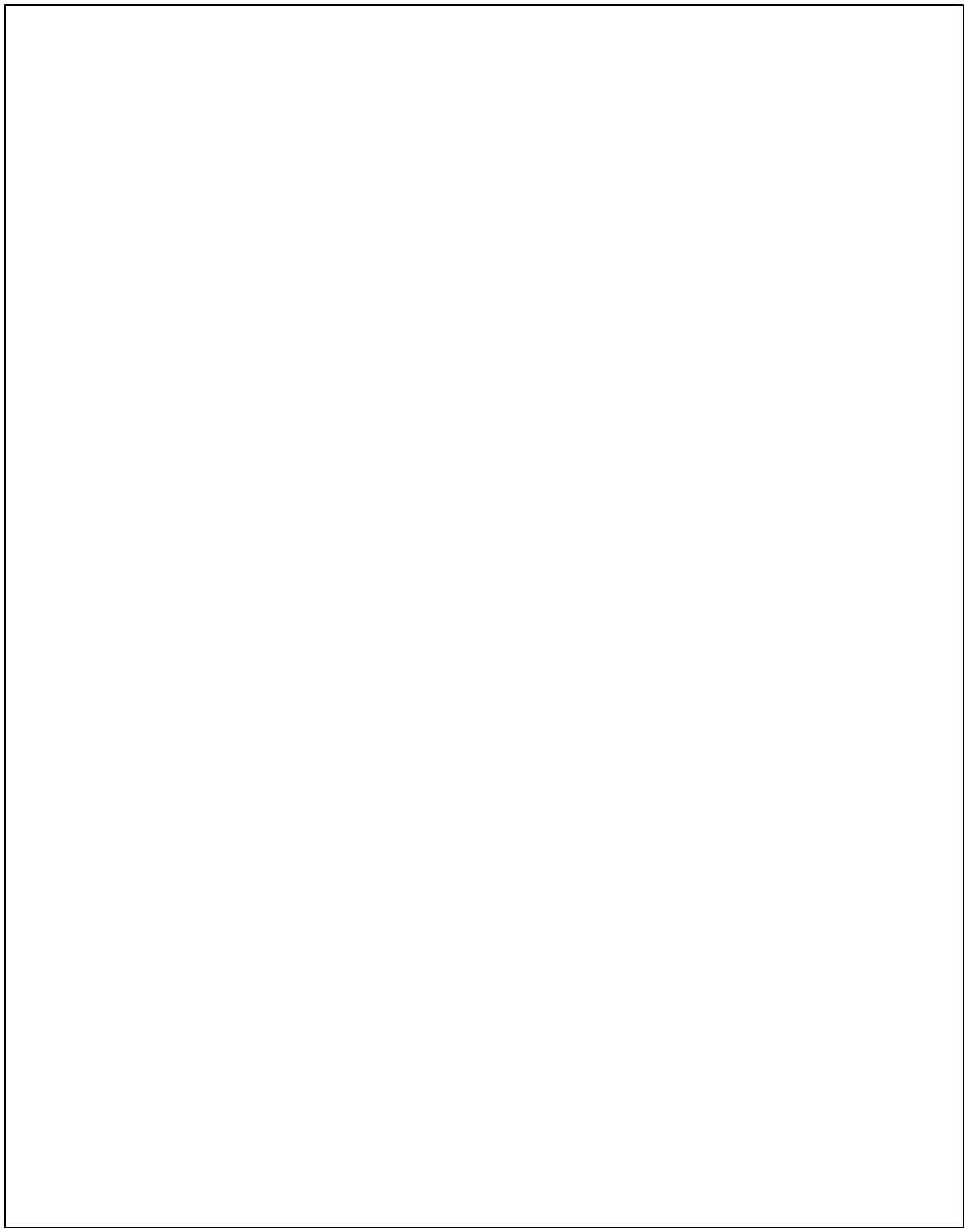

Figure 1. (A) The New Madrid seismic zone. Crosses indicate microseismic activity and the circles are the 3 major earthquakes of 1811-1812. (B) Shelby County in southwest TN. o = liquefaction dikes in river cut banks. C = Collierville, G = Germantown, E = Ellendale, Mne = Memphis Northeast, Mnw = Memphis Northwest quadrangles.

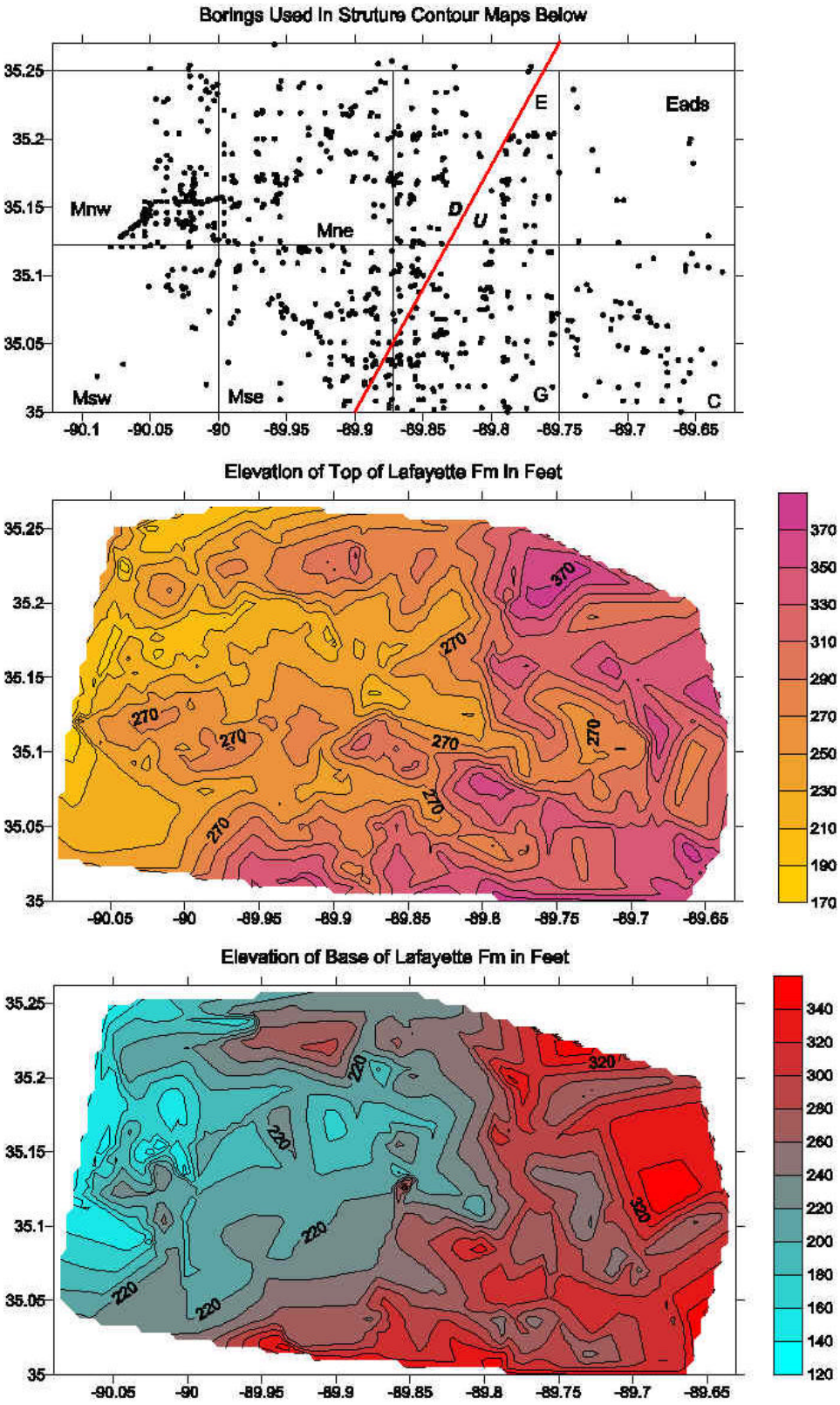

Figure 2. Top and bottom of Lafayette Formation. Note down-to-west apparent faulting.

Non Technical Summary

This project entails mapping the geology and liquefaction susceptibility of the Memphis Northeast, Germantown, and Ellendale 7.5 minute topographic quadrangles in Shelby County, Tennessee at a scale of 1:24,000. Geologic maps are nearly complete for the Memphis Northeast and Germantown quadrangles and mapping in the Ellendale quadrangle is in progress. We have identified a possible subsurface, Quaternary age (<10,000 year old), down-to-the-west fault with 100 feet of displacement. The apparent fault trends N30E through the eastern portion of the Memphis Southeast quadrangle, the northwestern corner of the Germantown quadrangle, and through the central portion of the Ellendale quadrangle. Additional work is necessary to determine if the fault is a seismic threat to the city of Memphis and Shelby County, Tennessee.

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Reports Published

Broughton, A.T., Van Arsdale, R.B., and Broughton, J.H., 2001, Liquefaction susceptibility mapping in the city of Memphis and Shelby County, Tennessee. Engineering Geology, v. 62, n. 1-3, p. 207-222.

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